



Evaluating water quality at public beaches for the protection of public health

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**WATER QUALITY
ADVISORY**

BACTERIAL LEVELS HERE CURRENTLY
EXCEED STATE STANDARDS.
CHILDREN, ELDERLY AND THOSE IN ILL.
HEALTH ARE ADVISED NOT TO SWIM.

2000 Edition of Florida Statutes

IN COOPERATION WITH

- Northeast Ohio Regional Sewer District
- Ohio Water Development Authority
- Ohio Lake Erie Office
- Cuyahoga County Board of Health
- Cuyahoga County Sanitary Engineers
- Cuyahoga River Community Planning Organization
- Lake County Health Department

Expand on 1997 study

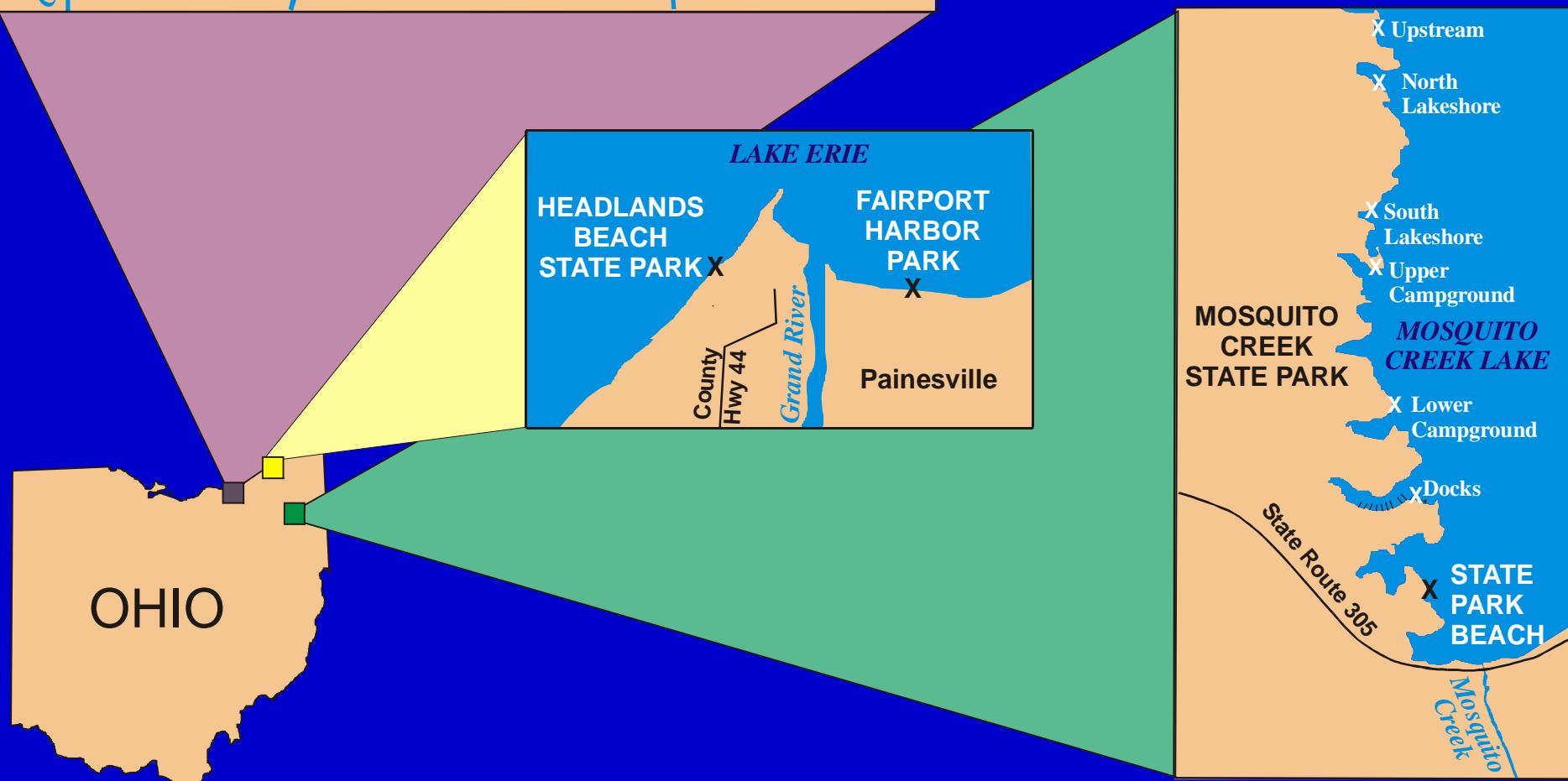
- Improve and evaluate existing *E. coli* predictive models for two beaches
- Develop models for other beaches
- Test the use of chemical sewage tracers
- Identify storage of *E. coli* in sediments
- First steps toward implementing a beach notification program

FIELD STUDIES

2000 AND 2001

- **REGULAR STUDIES** to improve/develop predictive model(s)
- **SOURCE IDENTIFICATION STUDIES** to gain knowledge on new tests, sources and processes of *E. coli*

Beach study sites



SOURCE IDENTIFICATION STUDIES

- *E. coli* in water and sediment
 - bathing
 - outside bathing area
 - interstitial zone

SOURCE IDENTIFICATION STUDIES

- **chemical sewage indicators**
USEPA--caffeine, urobilin
USGS--wastewater chemicals
- **sediment particle size analysis**
- **interstitial sediment organic carbon**
- **field observations**
- **interstitial information**
spC, temperature, turbidity, depth to free water

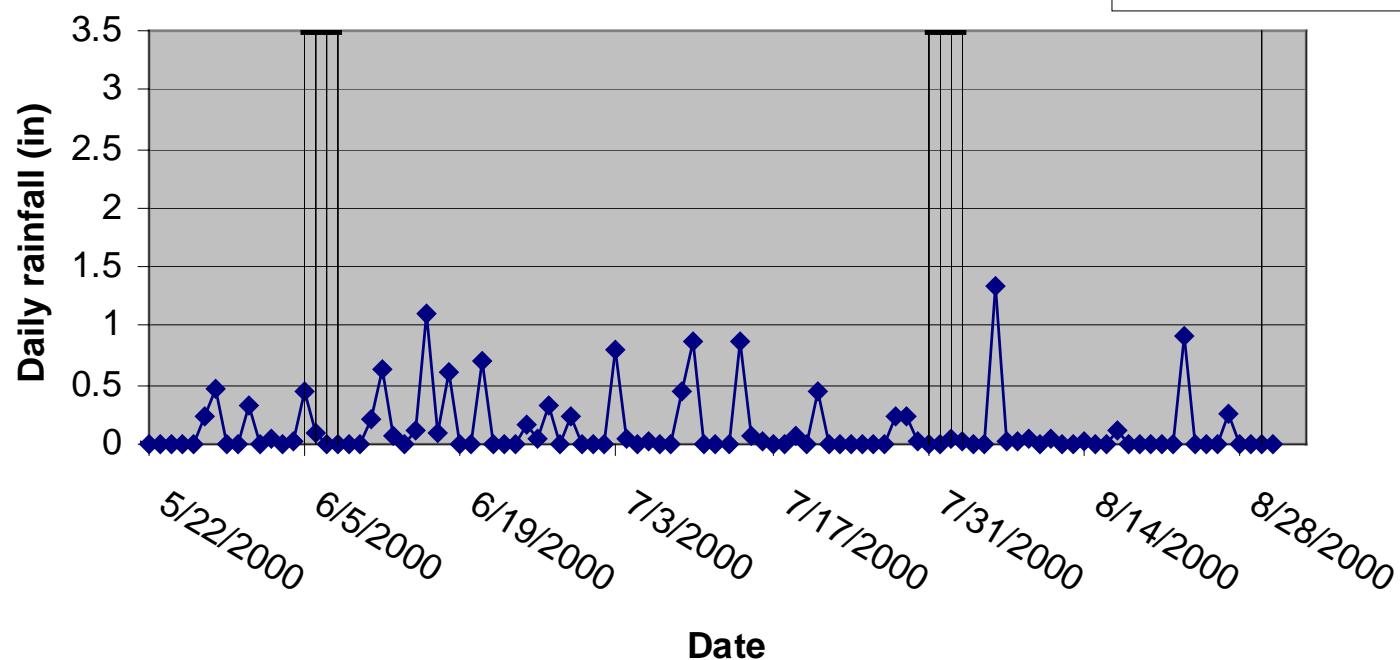
Source studies--Inland beach



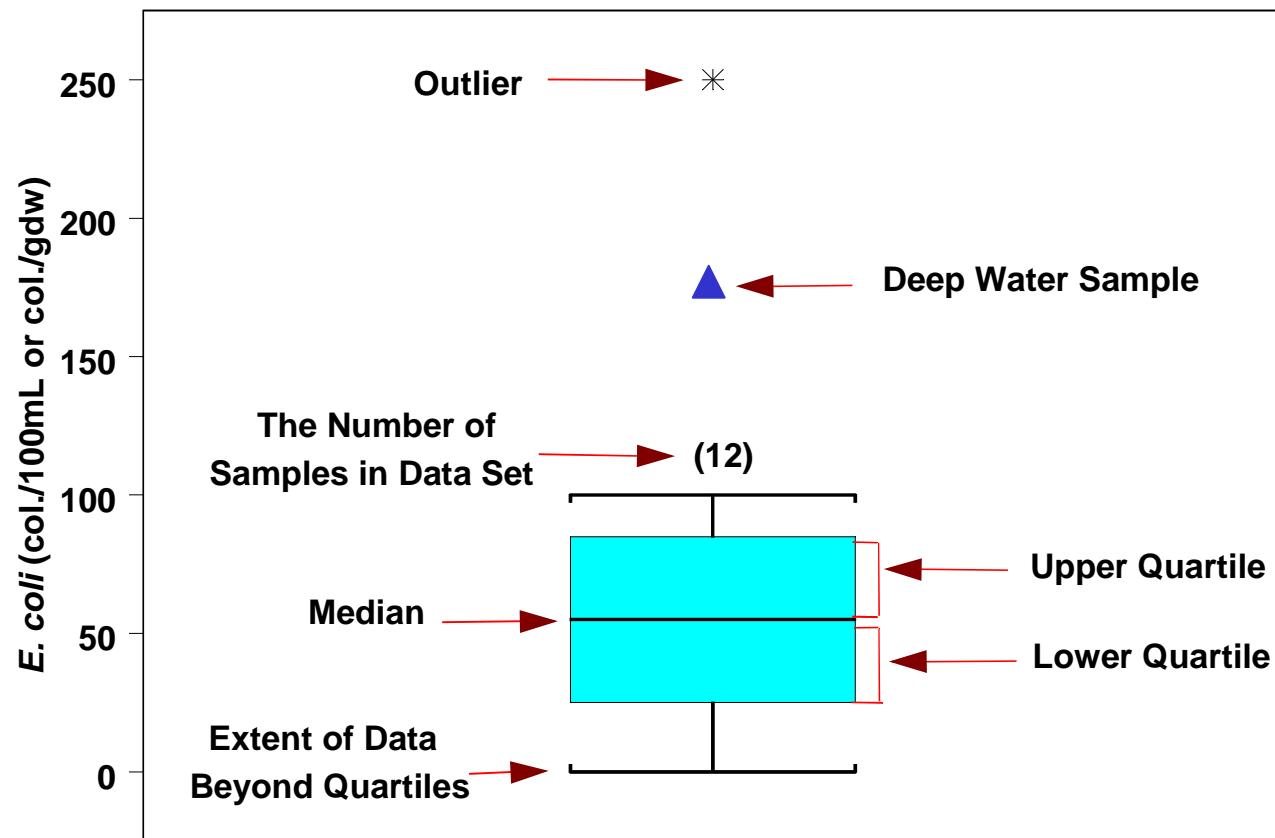
Mosquito Creek Lake, Cortland, Ohio

Youngstown Municipal Airport Weather Station (near Mosquito Creek Lake Beach)

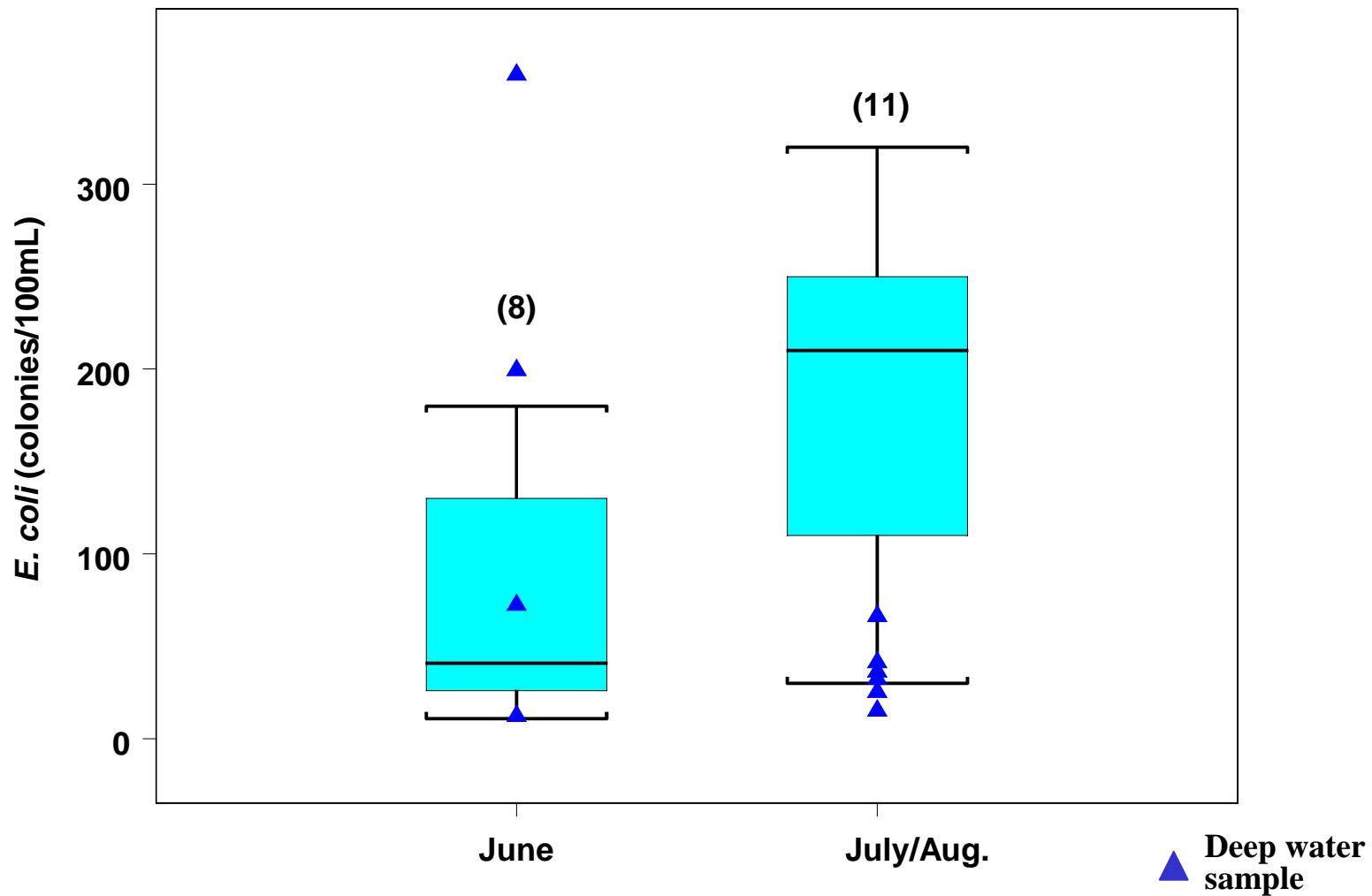
Rainfall
Sample dates



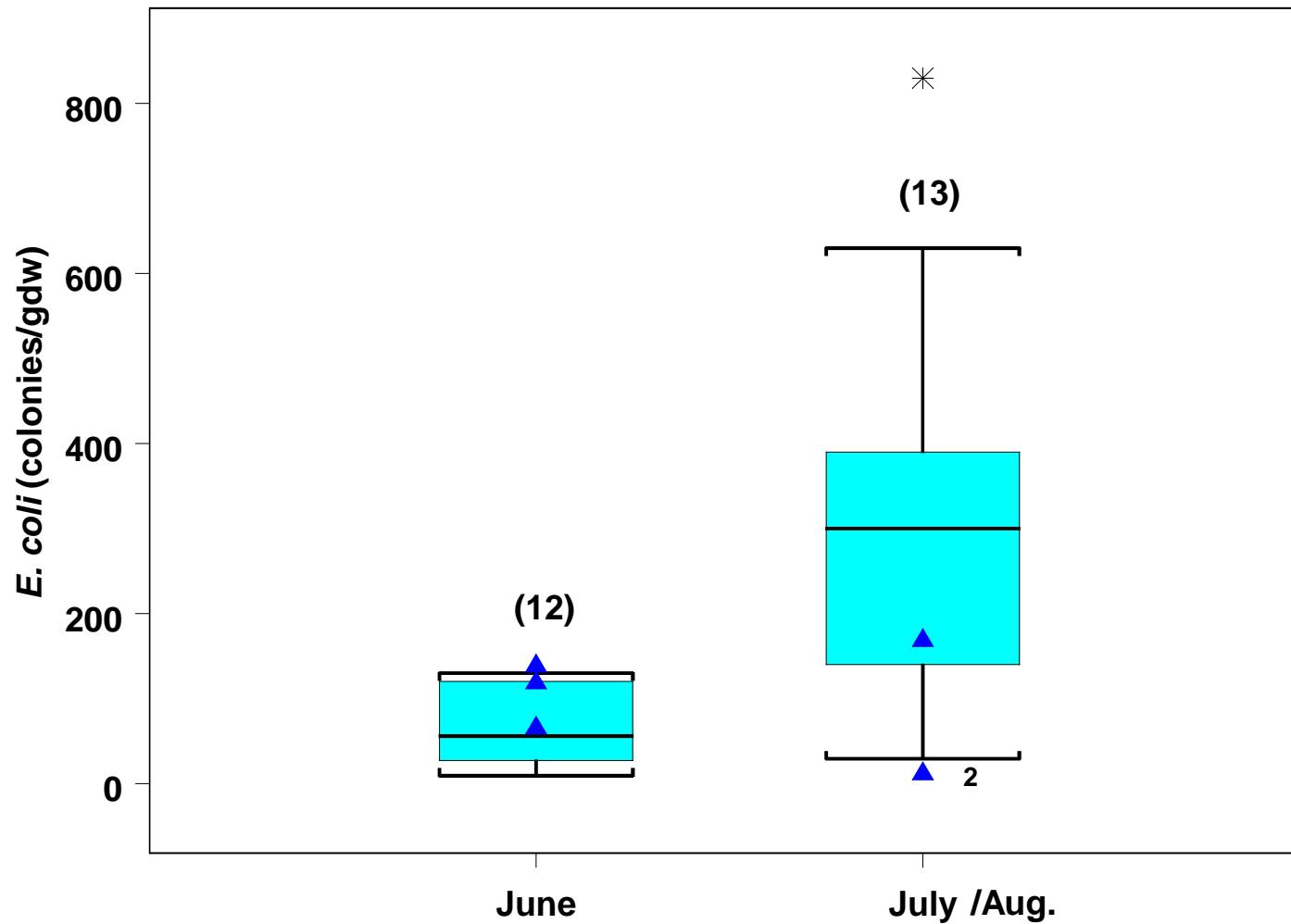
Box Plots



Mosquito Creek Lake Water Samples



Mosquito Creek Lake Sediment Samples



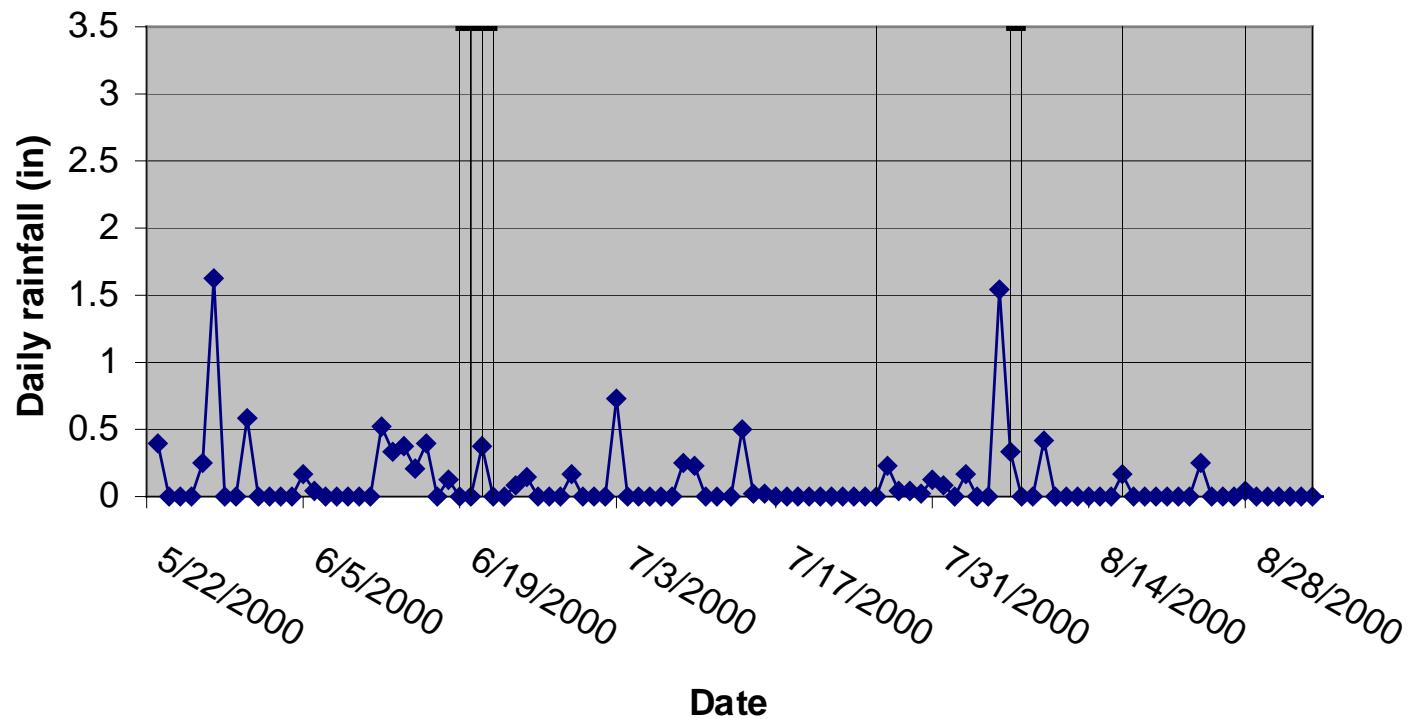
Source Studies--Lake Erie urban beaches



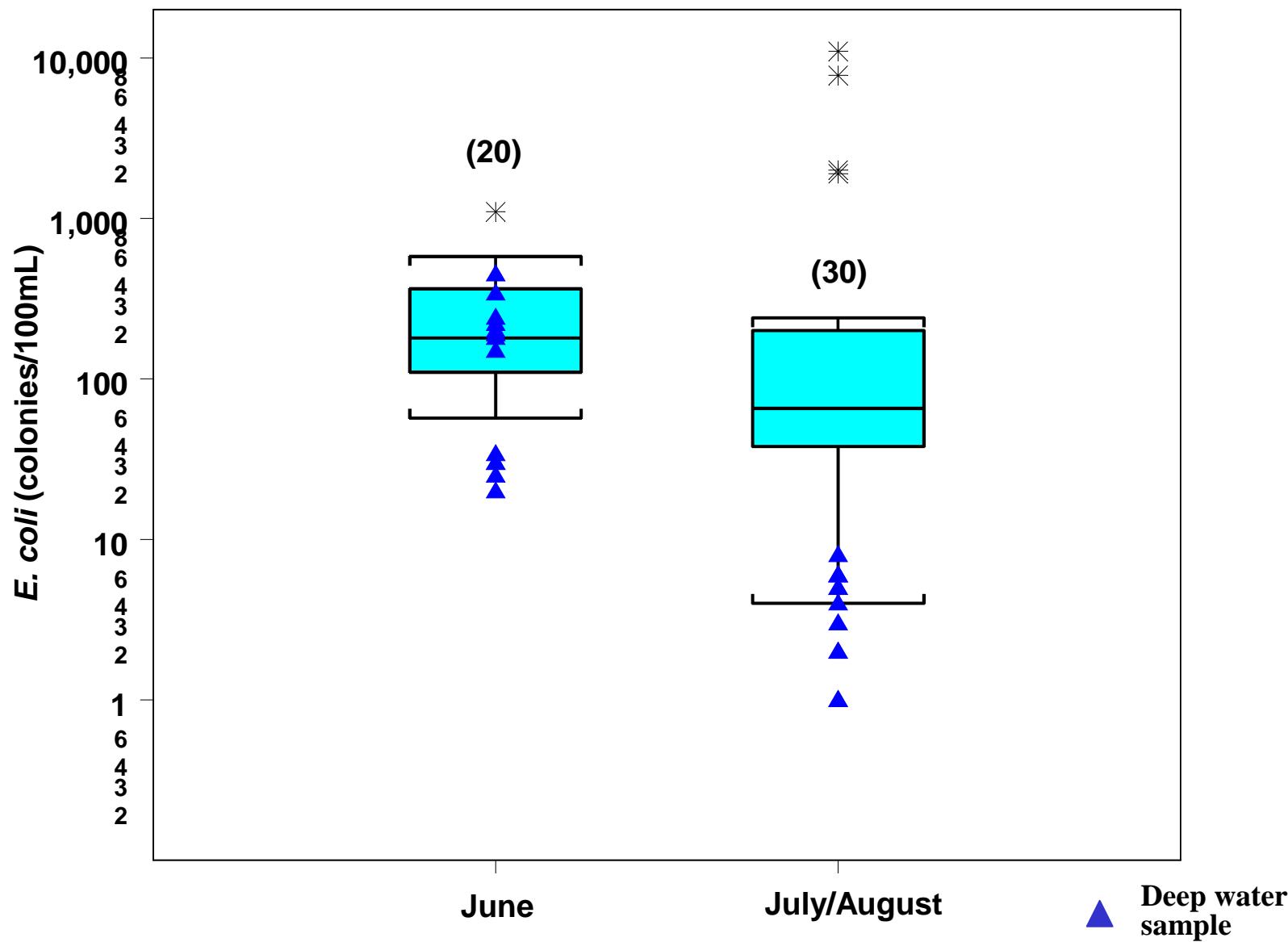
Huntington Beach, Bay Village, Ohio

Huntington Beach Rain Gage

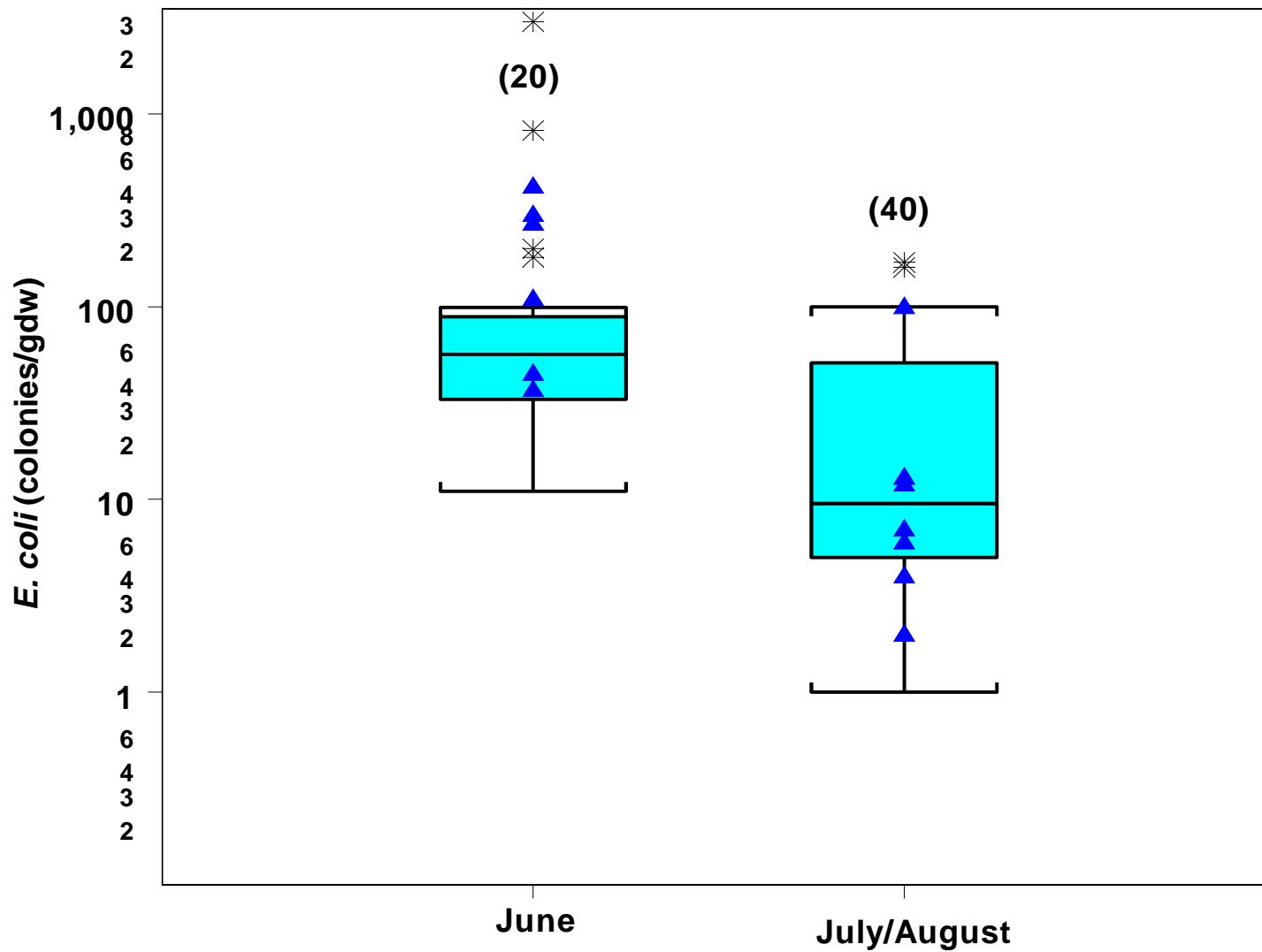
Rainfall
Sample dates



Lake Erie Water Samples



Lake Erie Sediment Samples



Interstitial sampling



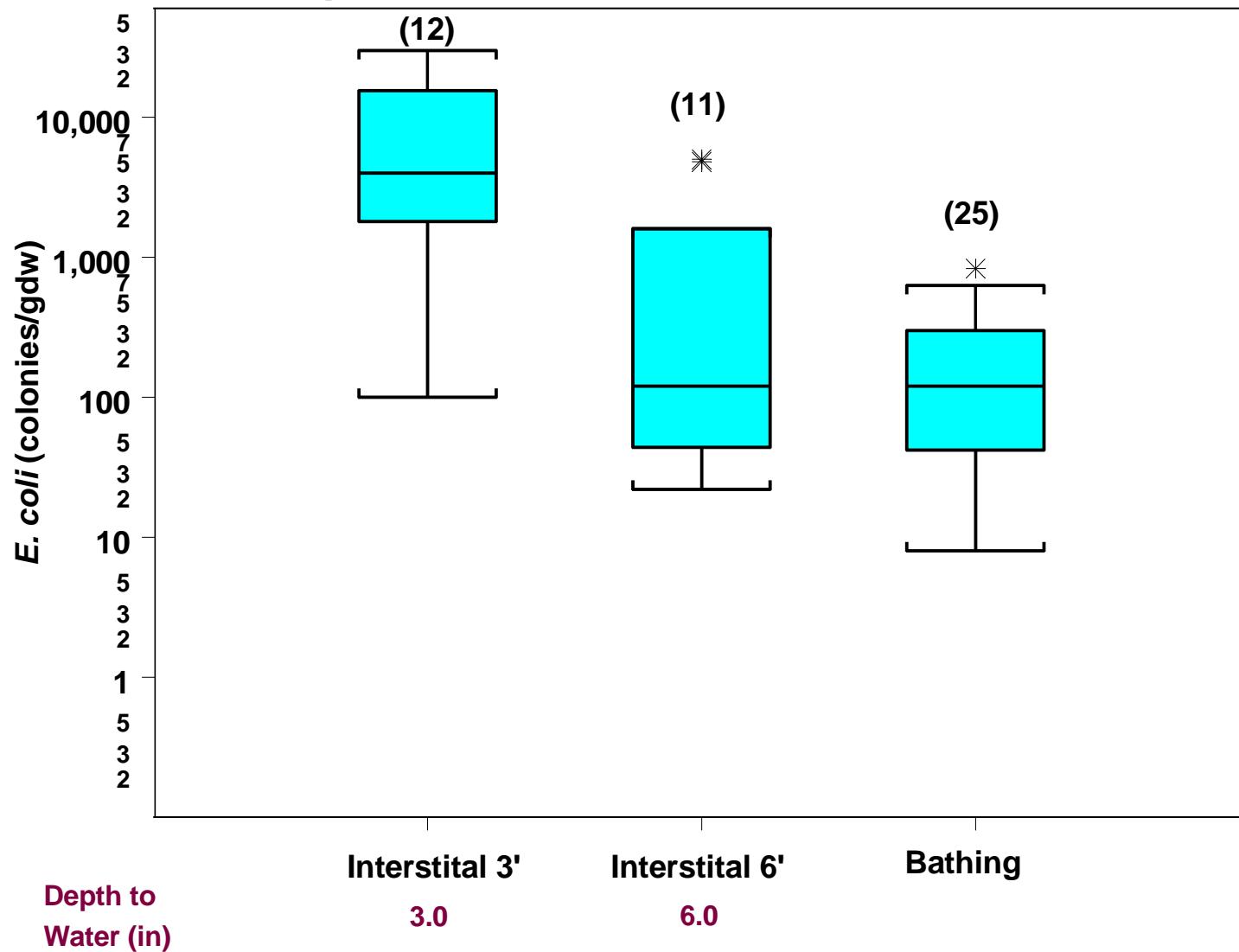
Sampling interstitial water



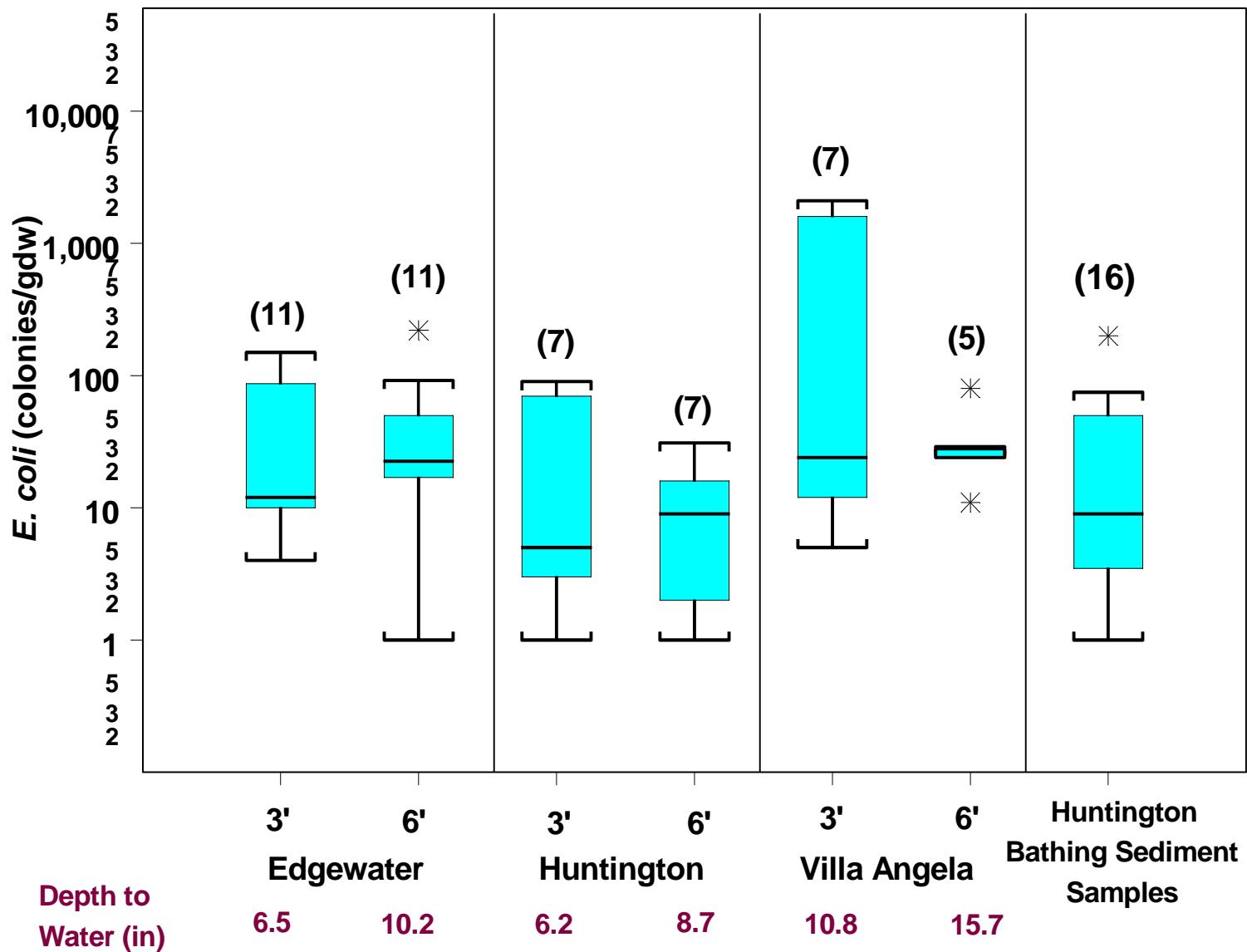
Sampling interstitial sediment



Mosquito Creek Lake Interstitial Sediments



Lake Erie Beaches Interstitial Sediments

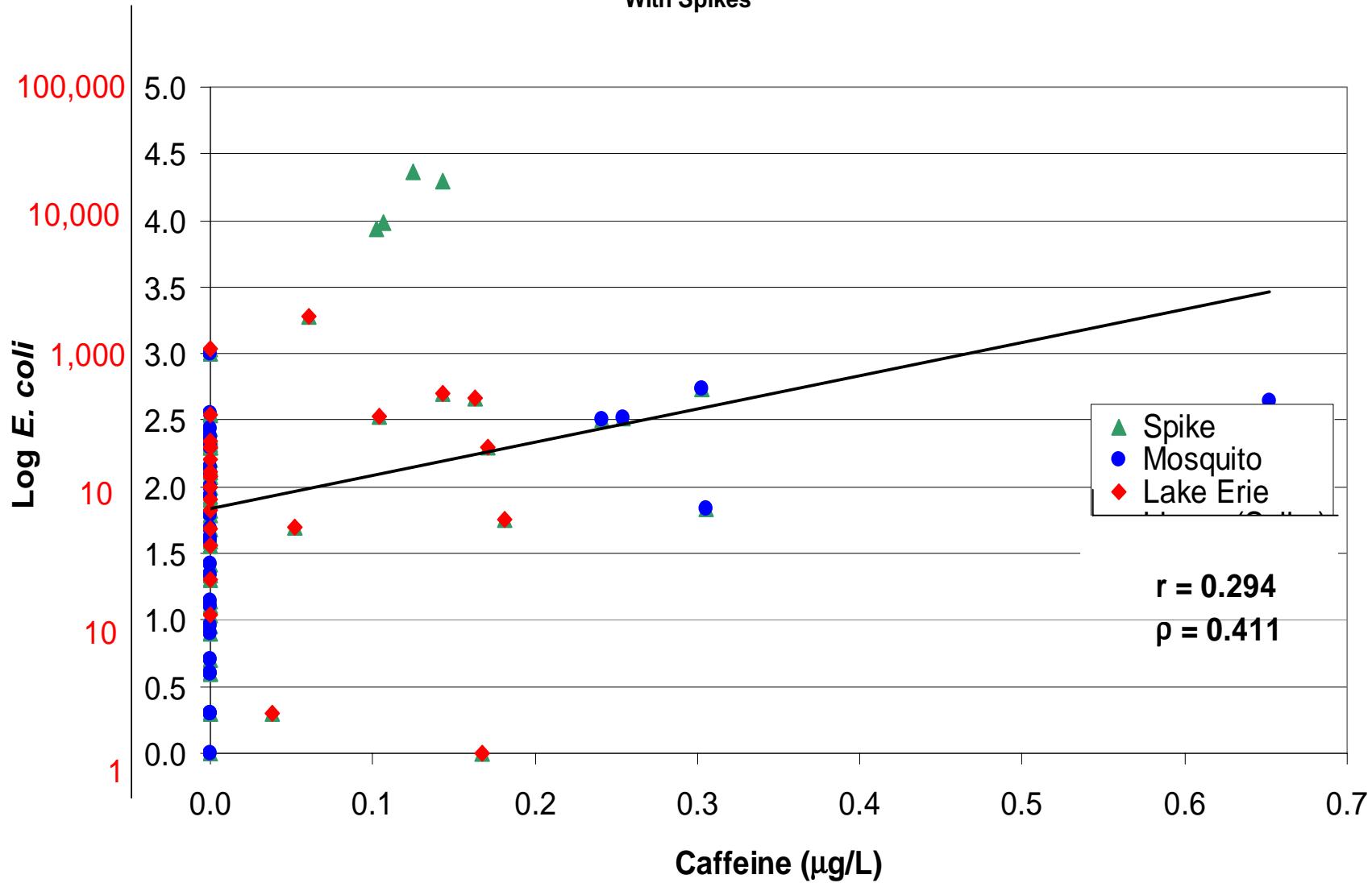


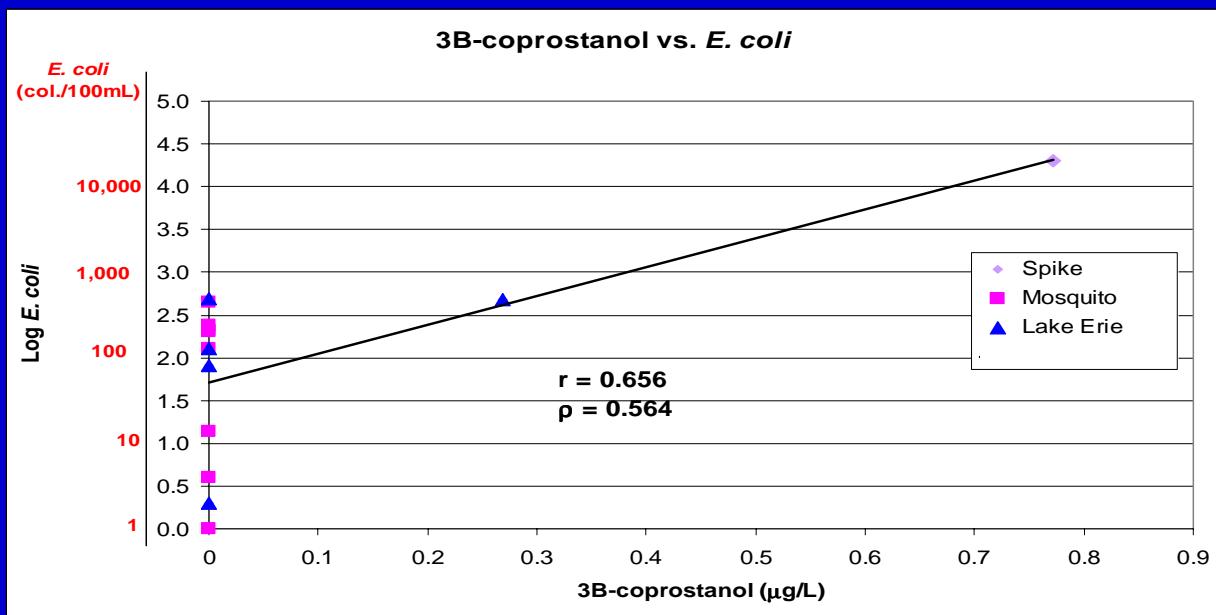
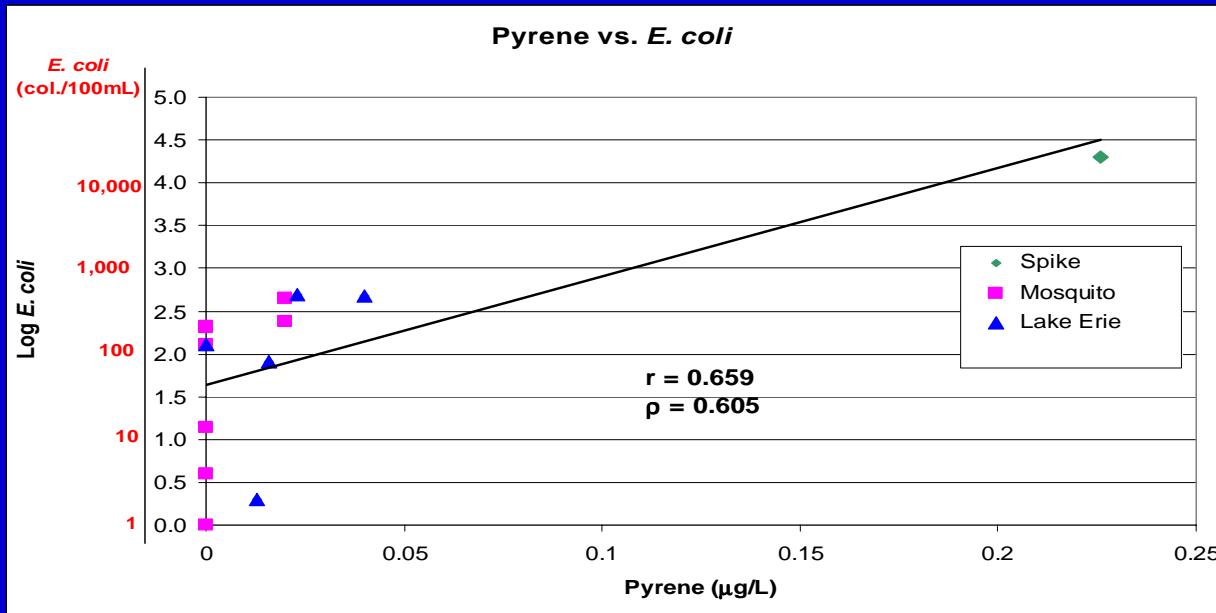
Chemical sewage indicators

Relations to log <i>E. coli</i>			
Analyte	# Detects (n)	Pearson's r	Spearman's p
Caffeine (USEPA)	19 (62)	0.402	0.445
Caffeine (USGS)	9 (14)	NS	0.739
Urobilin (USEPA)	2 (62)	NS	NS
Cholesterol	13 (14)	NS	NS
3-B coprostanol	2 (14)	0.656	0.564
NEPE01	7 (14)	NS	NS
NEPE02	0 (14)	-	-
Dichlorobenzene	2 (14)	NS	NS
Pyrene	7 (14)	0.659	0.605
Fluoranthene	7 (14)	0.582	0.590
Ethanol, 2-butoxy-,phosphate	5 (14)	NS	0.675
NS is not significant at alpha = 0.05			

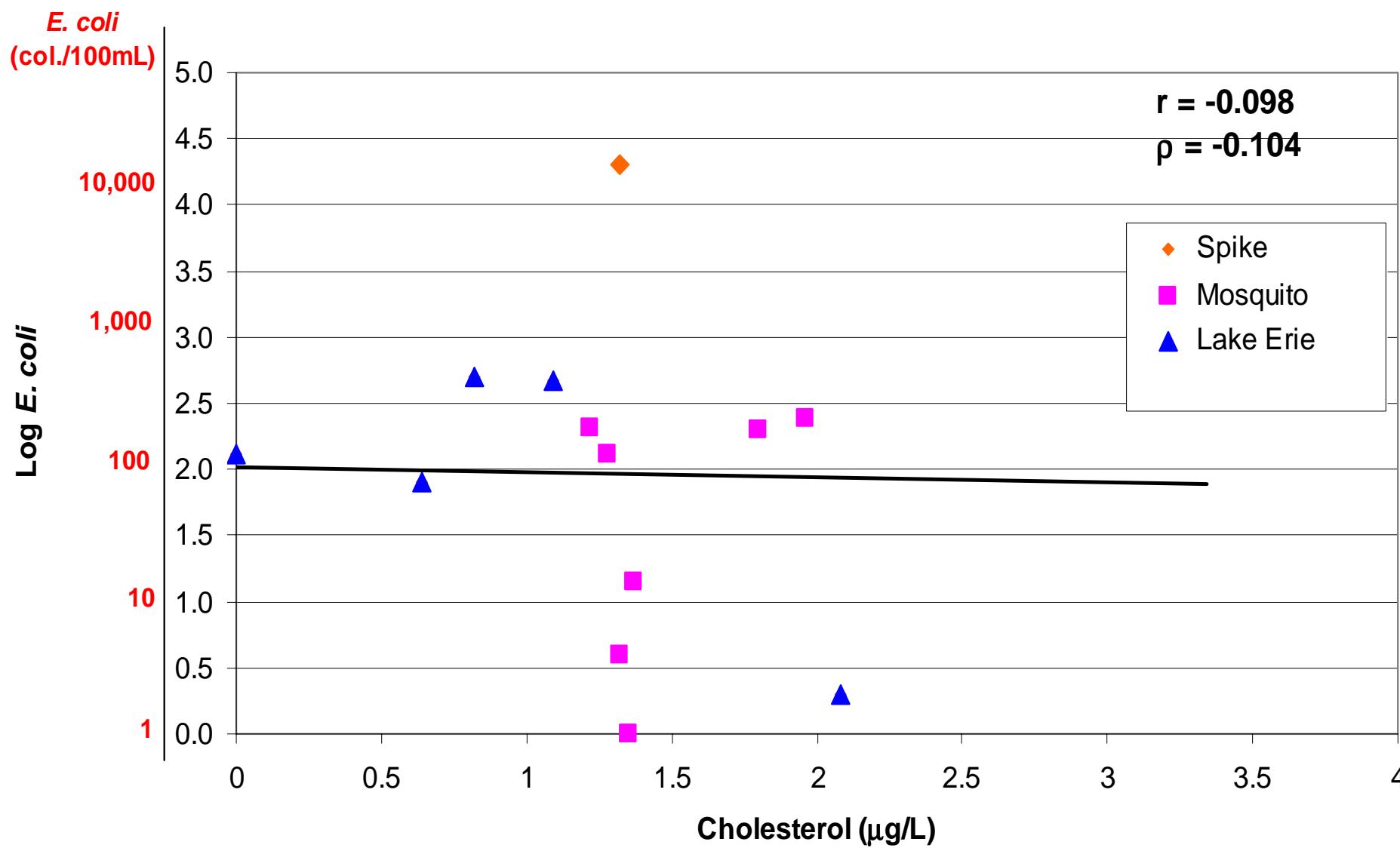
E. coli
(col./100mL)

Log E. coli vs. USEPA Caffeine With Spikes





Cholesterol vs. *E. coli*



REGULAR STUDIES

E. coli in water

Weekdays from Memorial Day to
Labor Day

- 3 Lake Erie urban beaches
- 2 Lake Erie beaches in less developed areas
- 1 inland Ohio State Park beach

Concentrations of *E. coli*, 2000

Beach	# of Samples (n)	No. (%) of days >235	% days >5 day GM	Median	Min.	Max.
				(colonies/100mL)		
Edgewater	72	24 (33%)	69%	140	4	12,000
Villa Angela	72	29 (40%)	67%	140	1	4,500
Huntington	52	11 (21%)	28%	120	8	6,600
Mentor Headlands	50	6 (12%)	7%	14	3	940
Fairport Harbor	49	3 (6%)	0%	16	2	390
Mosquito	53	15 (28%)	48%	110	6	5,400

VARIABLES (for model)

- rainfall amounts
- direction of lake currents (Edgewater)
- 156th Street overflow (Villa)
- stream flow data
- birds
- turbidity
- specific conductance (Mosquito)
- wave height
- wind direction (Mosquito)
- pool level, reservoir outflow (Mosquito)
- time

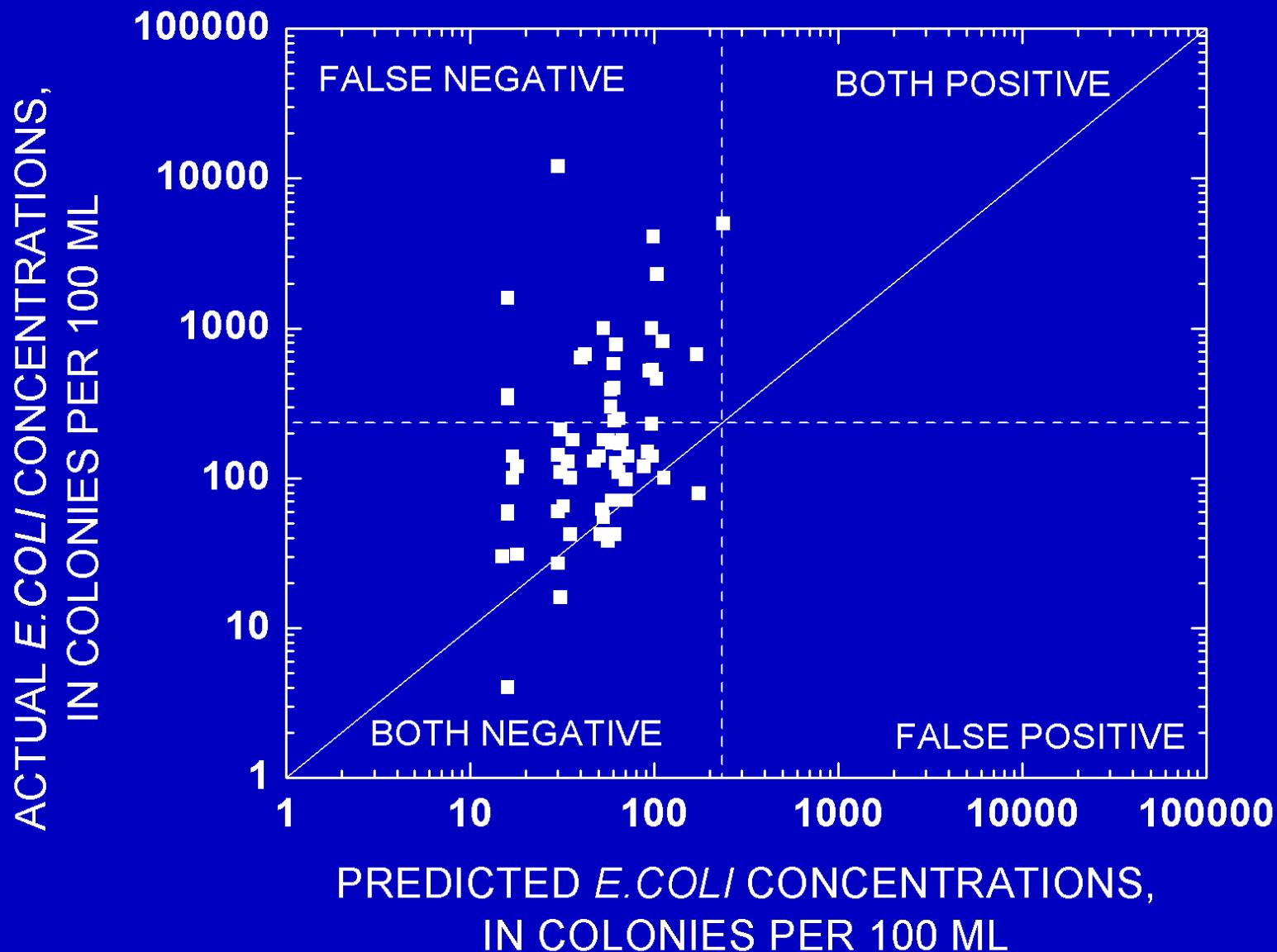
Correlations to log *E. coli*, 2000

Beach	Antecedent	Weighted	Stream	Number	Wave	Turbidity	Time
	Rain	Rain	Flow	of Birds	Height		
Edgewater	NS	NS	0.273	0.293	0.419	NS	NS
Villa Angela	0.424	0.332	0.309	NS	0.531	0.471	NS
Huntington	0.470	0.461	0.503	NS	0.522	0.673	-0.384
Mentor Headlands	NS	NS	NS	NS	0.451	0.327	NS
Fairport Harbor	NS	NS	NS	NS	0.321	NS	NS
Mosquito	NS	NS	NS	NS	--	0.495	0.518

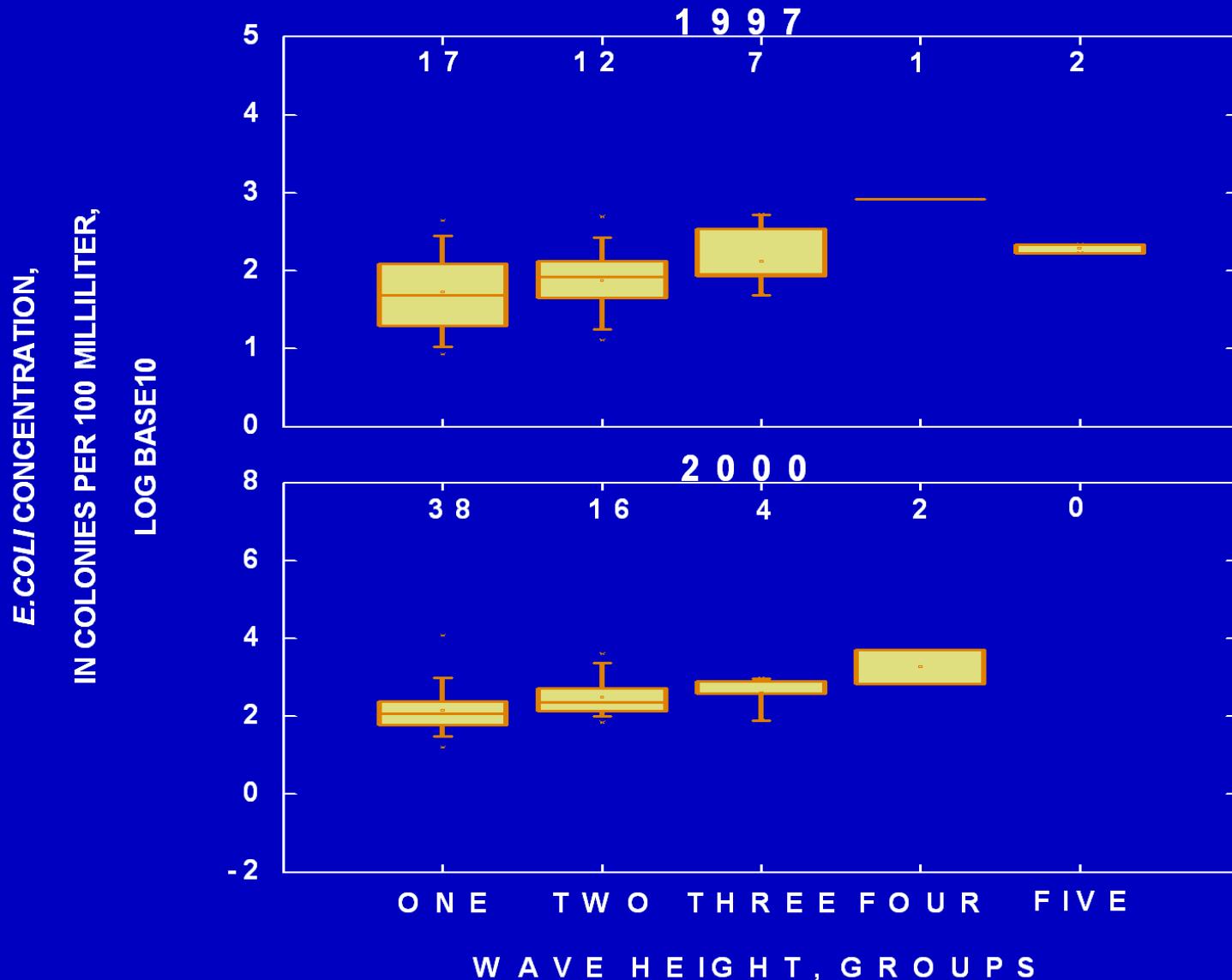
1997 predictive model

- **Uses wave height, turbidity, and antecedent rainfall**
- **Predicts the probability the standard will be exceeded**
- **Predicted recreational water quality as well as or better than current methods**

ACTUAL *E.COLI* CONCENTRATIONS FROM 2000 AND
VALUES PREDICTED BY THE 1997 MODEL,
EDGEWATER BEACH.



COMPARISON OF WAVE HEIGHTS, 1997 AND 2000, EDGEWATER BEACH, CLEVELAND, OHIO

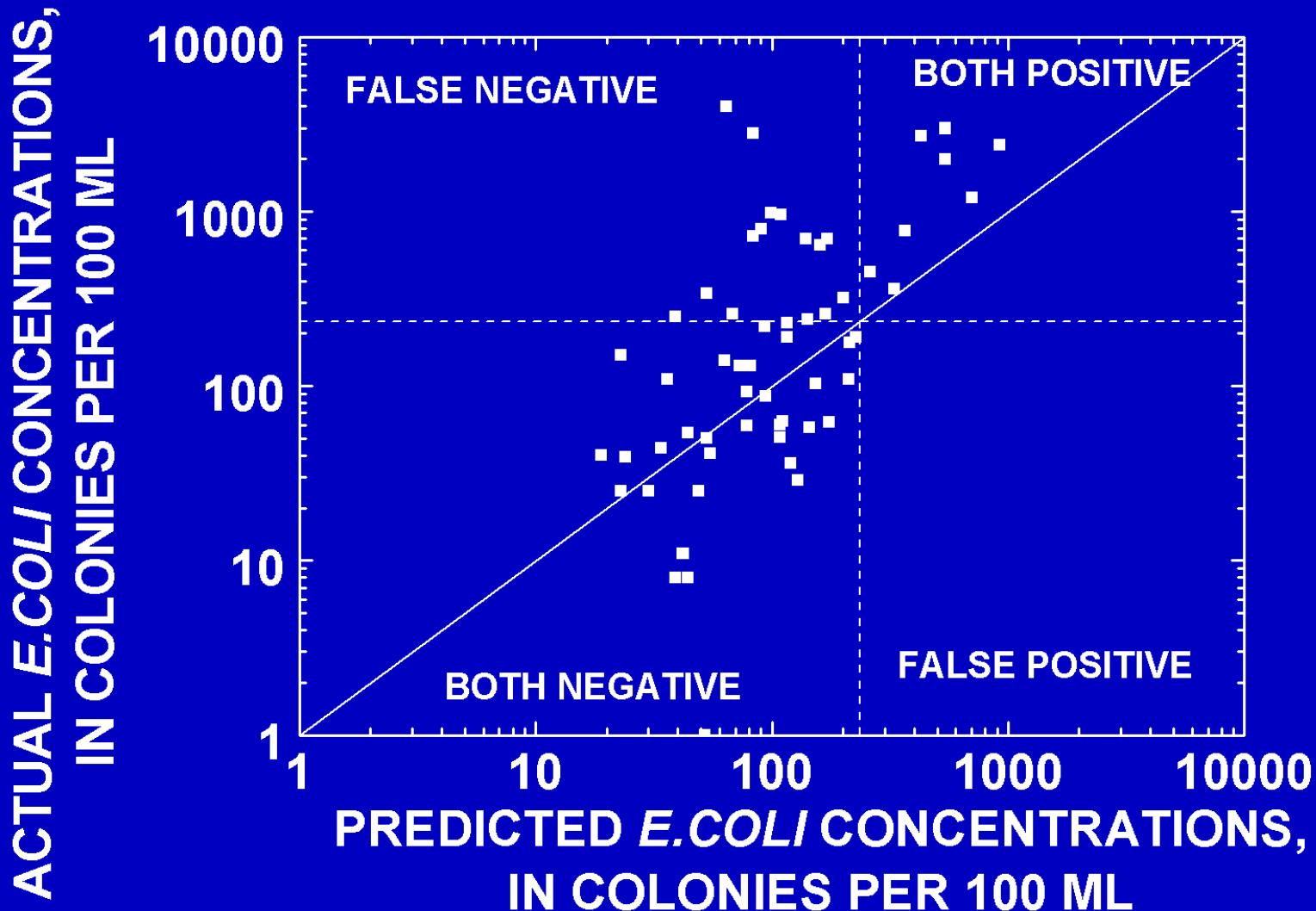


Edgewater

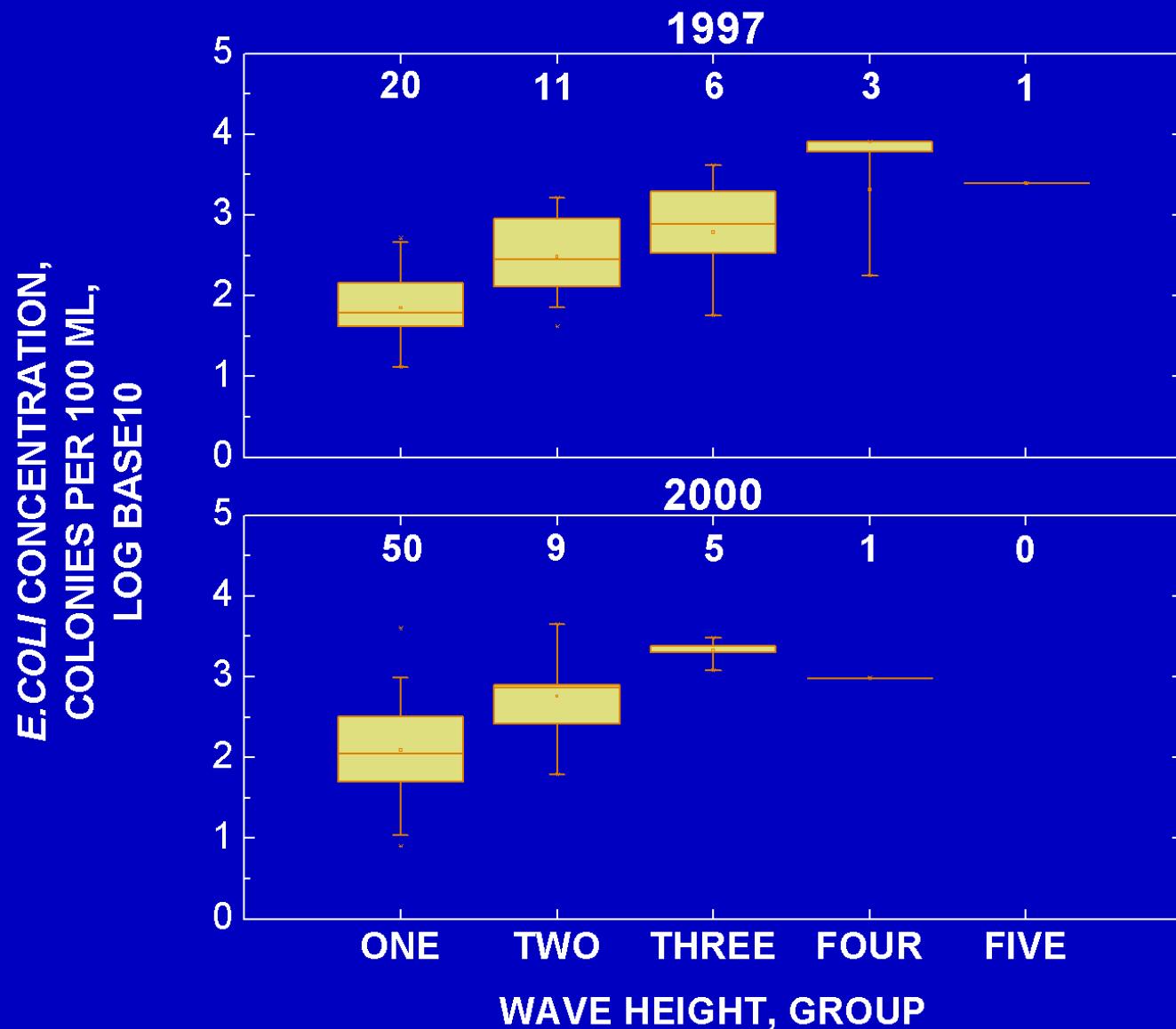
Differences between 1997 and 2000

Year	Median	Min.	Max.	Correlation	Total
Antecedent Rain					
1997	0	0	1.09	0.420	13.72
2000	0	0	8.70	NS	45.53
Turbidity					
1997	10	3	52	0.392	--
2000	4	0.6	14	NS	--
<i>E. coli</i>					
1997	86	9	830	--	--
2000	160	16	12,000	--	--

ACTUAL *E.COLI* CONCENTRATIONS FROM 2000 AND
VALUES PREDICTED BY THE 1997 MODEL, VILLA
ANGEL BEACH.



COMPARISON OF WAVE HEIGHTS, 1997 AND 2000, VILLA ANGELA BEACH, CLEVELAND, OHIO



Villa Angela

Differences between 1997 and 2000

Year	Median	Min.	Max.	Correlation	Total
Antecedent Rain					
1997	0	0	1.83	0.477	12.18
2000	0	0	3.41	0.425	20.05
Turbidity					
1997	6	2	74	0.645	--
2000	3	0.3	16	0.471	--
<i>E. coli</i>					
1997	150	13	8,100	--	--
2000	140	1	4,500	--	--

What's next?

- Combine 1997 and 2000 data and develop new model(s)
- Develop models for other beaches
- Test the models during 2001
- Further investigate distribution of *E. coli* in sediments
- Continue testing for chemical sewage indicators
- Test a rapid *E. coli* method



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